MATLAB Practical III: Solutions

1. To plot only the 1 contour: `contour(peaks, [1 1])`.

2. Typically, `norm(1e-3*randn(32))` $\approx 10^{-2}$. Some eigenvalues of the perturbed matrices differ from the correct eigenvalues by about 0.5. Thus, the change in some eigenvalues is about 50 times as large as the perturbation.

   Note that a Grcar matrix can be created simply with `A=gallery('grcar',32);`. Type `help gallery` to see what other matrices can be created like this.

3. The largest dense matrix that fits into 128MB is of dimension $N = 2^{12} = 4096$. This matrix contains 2^{24} floating point numbers.

   MATLAB's sparse matrix data structure seems to require 12 bytes per entry: 8 bytes for the floating point number, plus 4 bytes to record the location of the entry in the matrix. (There is some additional overhead memory usage.) Suppose our matrix has precisely five non-zeros in every row. Then we can fit a matrix of dimension a little larger than $N = 2,000,000$ in 128MB of memory.

4. `I = sparse(eye(200))` first creates a full matrix (`eye(200)`), and then converts it to sparse format. This wastes both computing time and memory. If the matrix dimension was much larger, you would run out of memory to build the full matrix.

5. The matrix has 1216 non-zero entries. You can determine this by typing:
   `length(nonzeros(A))`

   This matrix could also have been created using `A=gallery('poisson',16);`.